Center Innovation Fund: GSFC CIF

Ultra-Low-Noise Sub-mm/FIR Detectors for Space-based Astrophysics

Completed Technology Project (2012 - 2017)

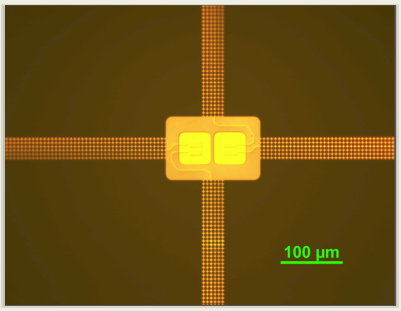
Project Introduction

The Ultra-Low-Noise Sub-mm/FIR Detectors for Space-based Astrophysics project develops structures that will improve the control of the thermal conductance in dielectric materials at sub-Kelvin temperature. This technology will enable the creation of more sensitive detectors for far-infrared astronomy that can be tiled into large arrays of many thousands of detectors.

The sensitivity of a thermal detector sensitive to submillimeter and far-infrared radiation is a function of the thermal conductance of the detector to its cryogenic environment. It has proven difficult to optimize the thermal conductance of standard uniform micro-mechanical dielectric beams with prior knowledge of material properties and geometry. It is also extremely challenging to optimize a beam dimension that satisfies all the requirements of a space-borne instrument. Efforts presently underway in the field have pursued long (> 1 mm) and narrow (< 0.5 microns) beams for achieving thermal conductances below 1 pW/K. Special emphasis has been placed on the characterization of the thermal conductance as a function of temperature, material, and geometry. In this work, we are engineering structures that block the flow of heat by design. By doing so we hope to construct new generations of detectors that are increasingly more sensitive and are compact so that large arrays of detectors can be constructed that will fill the focal planes of future NASA missions.

Anticipated Benefits

Future missions in the far-infrared will require kilopixel or larger arrays of ultra-low-noise space-worthy detectors. In the near future such detectors can enhance the capabilities of NASA's SOFIA airborne observators. Further in the future, space-based far-infrared missions that will vastly increase our knowledge of the cosmos will require extremely sensitive detectors. Such detectors are enabled by this technology.



Control of Dielectric Thermal conduction at sub-Kelvin Temperatures for Sensitive Cryogenic Detectors

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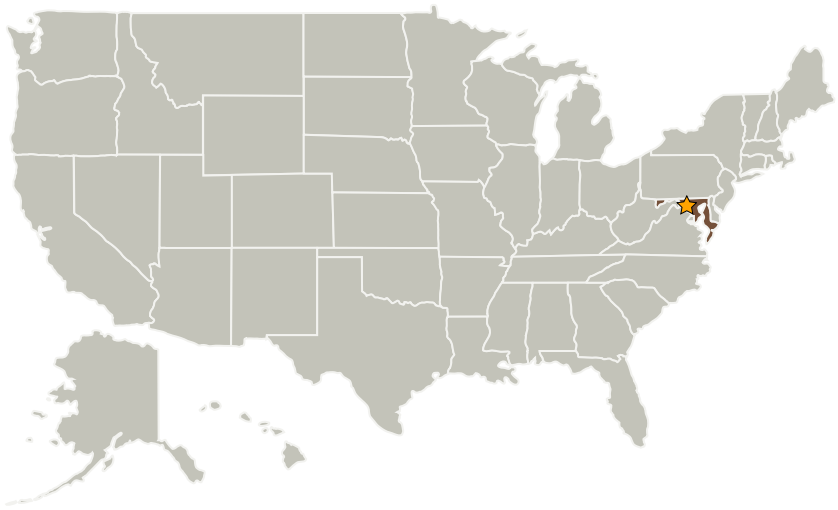

Organizations Performing Work	Role	Type	Location
★Goddard Space Flight Center(GSFC)	Lead Organization	NASA Center	Greenbelt, Maryland

Primary U.S. Work Locations
Maryland

Project Transitions

October 2012: Project Start

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Goddard Space Flight Center (GSFC)

Responsible Program:

Center Innovation Fund: GSFC CIF

Project Management

Program Director:

Michael R Lapointe

Program Manager:

Peter M Hughes

Project Managers:

Megan E Eckart
Timothy D Beach

Principal Investigator:

Kevin L Denis

Co-Investigators:

Karwan Rostem
Edward J Wollack

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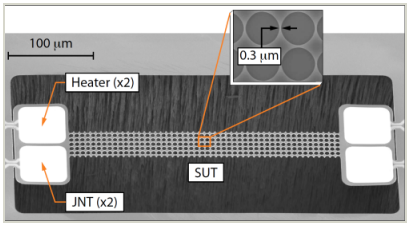
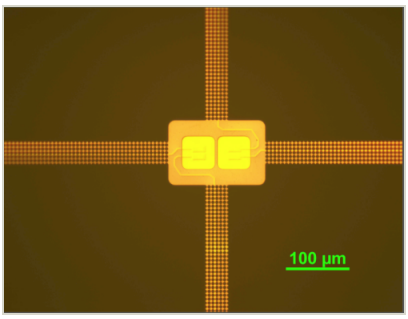
September 2017: Closed out

Closeout Summary: The purpose of the Goddard Space Flight Center's Internal Research and Development (IRAD) program is to support new technology development and to address scientific challenges. Each year, Principal Investigators (PIs) submit IRAD proposals and compete for funding for their development projects. Goddard's IRAD program supports eight Lines of Business: Astrophysics; Communications and Navigation; Cross-Cutting Technology and Capabilities; Earth Science; Heliophysics; Planetary Science; Science Small Satellites Technology; and Suborbital Platforms and Range Services.Task progress is evaluated twice a year at the Mid-term IRAD review and the end of the year. When the funding period has ended, the PIs compete again for IRAD funding or seek new sources of development and research funding or agree to external partnerships and collaborations. In some cases, when the development work has reached the appropriate Technology Readiness Level (TRL) level, the product is integrated into an actual NASA mission or used to support other government agencies. The technology may also be licensed out to the industry.The completion of a project does not necessarily indicate that the development work has stopped. The work could potentially continue in the future as a follow-on IRAD; or used in collaboration or partnership with Academia, Industry and other Government Agencies.If you are interested in partnering with NASA, see the TechPort Partnerships documentation available on the TechPort Help tab. http://techport.nasa.gov/help

Images



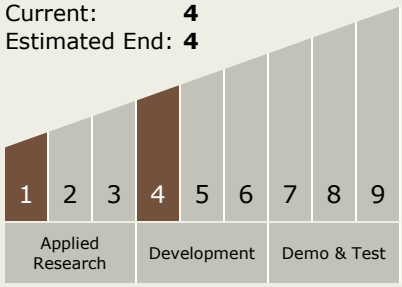
Control of Dielectric Thermal conduction at sub-Kelvin Temperatures for Sensitive Cryogenic Detectors
Control of Dielectric Thermal conduction at sub-Kelvin Temperatures for Sensitive Cryogenic Detectors *(https://techport.nasa.gov/image/3505)*



Control of Dielectric Thermal conduction at sub-Kelvin Temperatures for Sensitive Cryogenic Detectors
Control of Dielectric Thermal conduction at sub-Kelvin Temperatures for Sensitive Cryogenic Detectors *(https://techport.nasa.gov/image/3504)*

Technology Maturity (TRL)

Start: **1**
Current: **4**
Estimated End: **4**



Technology Areas

Primary:

- TX08 Sensors and Instruments
  - TX08.1 Remote Sensing Instruments/Sensors
    - TX08.1.1 Detectors and Focal Planes

Target Destinations

Outside the Solar System, Foundational Knowledge

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Links

GSC-17511-1
(no url provided)

Project Website:

http://sciences.gsfc.nasa.gov/sed/